HISTORY AND PHILOSOPHY OF SCIENCE IN BRAZILIAN BASIC EDUCATION: FOR A PROCESS OF BUILDING SCIENTIFIC KNOWLEDGE IN THE SCHOOL

A HISTÓRIA E FILOSOFIA DA CIÊNCIA NA EDUCAÇÃO BÁSICA BRASILEIRA: POR UM PROCESSO DE CONSTRUÇÃO DO CONHECIMENO CIENTÍFICO NA ESCOLA

LA HISTORIA Y LA FILOSOFÍA DE LA CIENCIA EN LA EDUCACIÓN BÁSICA BRASILEÑA: POR UN PROCESO DE CONSTRUCCIÓN DEL CONOCIMIENTO CIENTÍFICO EN LA ESCUELA

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ABSTRACT: The relations between the sciences, the historical context of their production and the philosophical conceptions prevailing in a given time become visible when considering the history of science. For it shows the links between history in the broad sense, that is, political, economic, cultural and social history, with the sciences themselves and with the philosophy of science. This article seeks to discuss the history and philosophy of science in basic education, its limits and possibilities. How basic education has been addressing science in school; how teacher education is working with future teachers in science at school; how is the history and philosophy of science placed in teacher education curricula and basic education, how do the areas talk and share the history and philosophy of science in the construction of knowledge? They propose to rescue the history and philosophy of science as historical knowledge constituted throughout the ages, as well as the evolution of science from the perspective of epistemologists such as Kunh (1971), Popper (19), Bachelard (1996). This work brings reflections on the limitations of science education in basic education and conclusions by contextualizing the importance of the history and philosophy of science being present in the curricula of teacher education and basic education.

KEYWORDS: History. Philosophy. Science. Teacher education. Basic education.

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***RESUMO**: As relações entre as ciências, o contexto histórico de sua produção e as concepções filosóficas vigentes em uma determinada época se tornam visíveis ao considerar a história da ciência. Pois ela mostra os vínculos entre a história em sentido amplo, quer dizer, história política, econômica, cultural e social, com as próprias ciências e com a filosofia da ciência. Esse artigo busca discutir a história e filosofia da ciência na educação básica, seus limites e possibilidades. Como a educação básica vem abordando a ciência na escola; como a formação de professores está trabalhando com futuros docentes a ciência na escola; como está colocada a história e filosofia da ciência nos currículos de formação de professores e na educação básica, como as áreas conversam e compartilham da história e filosofia da ciência quando da construção do conhecimento e de saberes. Se propõe a resgatar a história e filosofia da ciência enquanto saber histórico constituído através dos tempos, bem como a evolução da ciência a partir do olhar de epistemólogos como Kunh (1971), Popper (1994), Bachelard (1996). Traz reflexões acerca das limitações da educação em ciências na educação básica e finaliza contextualizando a importância da história e filosofia da ciência estar presente nos currículos de formação de professores e da educação básica.*

***PALAVRAS-CHAVE**: História. Filosofia. Ciência. Ensino aprendizagem. Educação básica.*

***RESUMEN**: Las relaciones entre las ciencias, el contexto histórico de su producción y las concepciones filosóficas vigentes en un momento dado se hacen visibles al considerar la historia de la ciencia. Porque muestra los vínculos entre la historia en un sentido amplio, es decir, la historia política, económica, cultural y social, con las ciencias mismas y con la filosofía de la ciencia. Este artículo busca discutir la historia y la filosofía de la ciencia en la educación básica, sus límites y posibilidades. Cómo la educación básica se ha acercado a la ciencia en la escuela; cómo la formación docente está trabajando con futuros profesores de ciencias en la escuela; cómo se coloca la historia y la filosofía de la ciencia en los planes de estudio de educación docente y la educación básica; cómo las áreas hablan y comparten la historia y la filosofía de la ciencia al construir el conocimiento y el conocimiento. Proponen rescatar la historia y la filosofía de la ciencia como conocimiento histórico constituido con el tiempo, así como la evolución de la ciencia desde la perspectiva de epistemólogos como Kunh (1971), Popper (1994), Bachelard (1996). Trae reflexiones sobre las limitaciones de la educación científica en la educación básica y termina contextualizando la importancia de la historia y la filosofía de la ciencia para estar presentes en los planes de estudio de educación docente y educación básica.*

***PALABRAS CLAVE**: Historia. Filosofía. Ciencias. Enseñanza del aprendizaje. Educación básica.*

Introduction: The sciences and their relationship to history and philosophy

The relationships between sciences, the historical context of their production and the philosophical conceptions in force at a given time become visible when considering the history of science. For it shows the links between history in the broadest sense, that is, political, economic, cultural and social history, with the sciences themselves and with the

philosophy of science. We know today from the classic works of Koyré (2001) and Kuhn (1957) that the scientist's practice is determined by the dominant conceptions of the world in the time in which he lives and by the historical situation at that time, even though he is not fully aware of them. We understand that philosophical assumptions establish the objects of study of sciences, the methods that are admissible in scientific practice, the criteria for formation of hypotheses, the way to verify them, the way to expose sciences in textbooks and to teach them.

Even in disciplines as abstract as the mathematical sciences and apparently so little determined by their cultural environment, those influences can be verified. Indeed, the criteria for recognizing a set of arguments as a mathematical proof have varied with the ages. For a long time, it was thought, according to the Aristotelian principle of incommunicability of genders, that a geometric proof could not use arithmetic and algebraic considerations (ARISTÓTELES, 1979, p. 44-45). Many centuries later, in his Geometry, Descartes used algebraic tools in his demonstrations. The justification of his procedure was given in the first of his *Rules for the direction of the spirit*, when he established the unity of all sciences (translation OLASO; ZWANCK, 1995)

Another example well known by historians of science is that of the determination of the structure of the solar system, in the 16th and 17th centuries. We know that Ptolemy, Copernicus, Kepler, Galileo and Tycho Brahe formed different astronomical hypotheses. Ptolemy and Copernicus believed that the motion of the planets should be explained in terms of the composition of circular motions because they were both dependent on the ancient philosophical idea that circular motion is perfect motion, as it has neither beginning nor end, thus corresponding to perfect beings as the planets were considered (ANDRÉ, 1996; ANDREY *et al.,* 2007).

Kepler had the audacity to break this conception, but this was not free from philosophical influences. Indeed, the framework for the solar system he proposed shows that Kepler was guided by the hypothesis, dependent on Pythagorean philosophy, that there must be a correspondence between the number of regular polyhedra and the number of planets. If Copernicus placed the sun at the center of the solar system, it was because of the influence of neoplatonic ideas in force in the Renaissance, which were represented, among other authors, by Marsilio Ficino (KUHN, 1957, p. 154). Neoplatonic and Pythagorean elements are also found in Kepler's Astronomy.

It is possible to determine in detail the influence of the historical situation in which scientists live or have lived on their work. According to Andrey *et al.* (2007), medicine in the

Middle Ages was limited in its advance by the prohibition, which came from classical antiquity, to dissect human cadavers. Thus, physicians' knowledge of human anatomy was restricted to what could be apprehended through the dissection of animals. The author also explains that, at that time, surgeries were not performed by the doctor, but by the barber, a practical man. The doctor, based on his readings of the ancient masters of classical antiquity, Hippocrates and Galen, prescribed which treatments should be performed, including surgery among them. (ANDREY *et al.,* 2007).

The great advance in medical knowledge took place when, in the 17th century, as a consequence of the mechanistic conception of Nature and Cartesian dualism, the human body was no longer seen as something sacred and started to be considered as a simple machine. According to André (1996), we found a whole cultural environment that made this new conception possible: machine builders (mechanics) gained social prestige and money at that time, art began to represent the naked human body, philosophical and theological thought found its marks of divine action in the human soul and not in Nature, the soul being conceived by Descartes as a reality completely different from the body. In fact, Descartes proved the existence of God from the presence of the idea of God in the human soul, unlike what St. Thomas Aquinas, the greatest representative of medieval Scholastics, did, who intended to demonstrate the existence of God from the reality of movement in the Nature.

And yet, innovative scientists are not totally subordinated to a tradition, a certain historical and cultural situation in such a way that their freedom to think is totally restricted. They can, on the contrary, enrich and modify that tradition. But to appreciate their innovations, we must bear in mind the historical framework in which they developed their work. As Stengers tells us (2002, p. 12, our translation):

> The history of science does not have human beings "in the service of truth" as actors, if this truth must be defined according to criteria that escape history, but human beings "in the service of history", whose problem is to transform history and transform it in such a way that their colleagues, also those who, after them, will write the story, are obliged to speak of their invention as a “discovery” that others could have made.

Science and humanities of science in Brazilian basic education

Brazilian Basic Education comprises children and young people from 6 to 18 years of age, totaling 12 years of study. The Brazilian public education system was created at the end of the 19th century, at a time when Comte's positivism was strongly in force in the country, which was adopted by the political elite as a modernizing ideology. At that time, the country

had been transformed into a Republic, leaving behind the monarchical regime linked to slaveholders. As is well known, positivism had a linear conception of the intellectual evolution of Humanity. The superior stage of this evolution corresponds, according to Comte, to Science, which would surpass Philosophy and Religion. Comte's time corresponds to a period of great development of the exact and natural sciences. It is also the time of the industrialization of Europe, a time when positivists thought that the methods used in the natural sciences could serve to build a science of man and society. It was at that time that the human sciences emerged (ANDREY *et al.,* 2007).

For our theme, it is interesting to reflect on the influence of the positivist ideology on the formation of Brazilian education professionals, as well as its influence on school curricula. The positivists introduced in Brazil the physical and natural sciences in primary and secondary schools. Positivism in Brazil represented a break on the one hand with the so-called bachelor culture, represented by law graduates. This was a rhetorical and literary culture, based on legal Latin and on the study of codes and various theories on Law and the State. On the other hand, Brazilian positivism was also opposed to ecclesiastical culture, based on Catholic Theology and Scholastic Philosophy. Thus, Brazilian positivism placed itself in the name of science, and of progress, against the two branches of humanist education, in the way they were represented in Brazil at that time, namely, the rhetorical-literary and philosophical tradition (CHALMERS, 1993).

As the direction of education in the nascent republic was in the hands of people influenced by the positivist ideology, there was a divorce in the school environment between scientific culture and humanist culture, within which the teaching of history is found. This divorce persists to this day and shows up in textbooks used for teaching science at both elementary and high school levels. These texts barely mention the links between the sciences, history and philosophy. And when they mention them, they do it in a simplified way.

A consequence of the positivist conception in Brazilian education was that it reinforced the idea that school subjects are isolated from one another and should be dealt with in this way. Even though more than 120 years after this positivist conception was introduced in Brazil, traces of it can be found in the school environment. Even with the division into 4 areas of knowledge (languages, mathematics, humanities and natural sciences), we still find little dialogue in the areas and between areas, the discussion of science in the construction of scientific knowledge with a view to the development of students' citizenship.

The History of Science and the Science Teaching and Learning Process in Basic Education

Educational concepts linked to positivism have, among others, these defects: not being able to properly understand school failure in learning scientific subjects and not contributing to making this learning meaningful. It is still common today to attribute failure in scientific disciplines to the student. He would not have the talent for mathematics or his abilities for attention and observation would be limited, or would not relate concepts and situations, nor would he perceive similarities and analogies. However, if the teacher goes further, he would realize that the difficulties presented by the students often result from the fact that they are linked to conceptions arising from common sense.

This common sense is not only the product of outdated scientific ideologies or doctrines, but it is also based on the way our senses perceive the world and on the way our minds work. Common sense is a psychic, social and cultural product. We must bear in mind that if Humanity took so long to know that the Earth is moving, it is because we have not noticed its movement, unlike what happens when we are inside a moving car.

A person who has never taken elementary physics classes will tend to believe that the heavier body falls faster than the lighter one. Certainly, most people believe that a three-dimensional figure whose sides are infinite necessarily has infinite volume, even though Torricelli showed about four hundred years ago that this is not always the case. Many people think that a whale is a fish, and they do not see more than a stone in a fossil. For the layman, a table is something solid and compact, while for the physicist and for the person who has mastered the rudiments of this science, any table is a compound of atoms and these are not something compact, they are not a full space, but they include a large part the empty.

Common sense, based on our sensory perception, leads us to believe that the Sun is two or three times larger than the Moon. And yet, science tells us that the diameter of the first star is 1,391,000 km and the second is just 3474.2 km. These beliefs, which are imposed on the scientific knowledge taught by the school system, we call errors, as they are rooted in our language and our culture. If the student has difficulties in mastering certain scientific concepts and theories, it is because humanity had the same difficulties, and this is what the history of science shows (ANDREY *et al.,* 2007).

In the 20th century, the epistemologist Gaston Bachelard called epistemological obstacles these individual and collective barriers to the construction of scientific knowledge. He brought to the discussion the notion of epistemological obstacles as the steps to be overcome for the acquisition of scientific knowledge, that is, to move from already known

knowledge to new knowledge, there are obstacles to be overcome. We can say that these are the obstacles that the child in their cognitive development and Humanity in the construction of science had to overcome. If the student takes a long time to understand a principle such as the law of inertia or the concepts of negative and imaginary numbers, or the laws of Kepler or the evolutionary links between different species, it is because Humanity itself was slow to reach this knowledge.

> The evolution of sciences is hampered by epistemological obstacles, including common sense, perceptible data [...]. To be able to overcome them, epistemological acts are necessary: rupture with previous knowledge, followed by its restructuring (BACHELARD, 1996, p. 62, our translation).

Bachelard stresses the need to break with knowledge based on common sense. This knowledge is concrete, based on sensory perception, whereas scientific knowledge tends towards abstraction. According to Bachelard (1996, p. 49, our translation),

> [...] the act of knowing takes place against previous knowledge, overcoming what, in the spirit itself, is an obstacle to spiritualization [...]. This means that the successive contradictions of the past, which appear as authentic epistemological ruptures, would be the driving force behind the development of scientific knowledge. In this sense, the history of science would advance based on successive epistemological ruptures.

The history of science for Bachelard shows the successive overcoming of epistemological obstacles. In this process, knowledge is seen as advancing progressively, approaching the truth through a long work of construction and rectification, breaking with previous knowledge (SAITO, 2013). This is how the history of science must be presented in schools, showing the processes that led to the overcoming of epistemological obstacles that emerged in the attempt to understand nature. Thus, the process of building scientific knowledge becomes more accessible and clearer not only for the student, but also for the teacher.

Previous knowledge of students' daily lives should not be seen only as individual errors but as ways that our species has to approach Nature. At the beginning of the modern age, Francis Bacon, in his *Novum Organum*, spoke about the obstacles that hinder our conception of the world. He called them idols. Tribal idols stem from the structure of our intellect, forum idols arise from our language, theater idols from wrong philosophical and scientific doctrines, finally cave idols are strictly individual errors, originated in our education and in our upbringing.

According to Nascimento and Carvalho (2004), knowing the historical past and the origin of scientific knowledge can be a motivating factor for students, it can make students realize that the doubt they encountered for learning a scientific concept was the same who found, in another historical moment, a scientist recognized today, that is, they realize that their doubts were present at some point in the process of building this scientific concept.

The history of science, according to Solbes and Traver (2001, p. 158, our translation), can make students:

> i Know better the aspects of the history of science that were generally ignored before and, consequently, show a completer and more contextualized picture of science;
> ii Appropriately value internal processes of scientific work, such as: the problems addressed, the role of discovery, the importance of experiments, mathematical formalism and the evolution of knowledge (crises, controversies and internal changes);
> iii Adequately value external aspects such as: the collective character of scientific work, the social implications of science.
> And they still claim that it can:
> iv Present a less topical picture of science and scientists;
> v Improve classroom climate and participation in the teaching-learning process.

The proposal for a more historic teaching is opposed to mechanical, cumulative and socially neutral teaching. The inclusion of the history of science and philosophy of science in school contents can contribute to the proposal of more challenging and creative classroom methodologies. Scientific and technological knowledge is currently part of human beings' daily lives, encouraging teachers to adapt their educational practices to this new reality, with strategies that make the teaching and learning process attractive and challenging for students. Making knowledge available to everyone, regardless of social class, culture, beliefs and values is a task for schools in the 21st century.

The permanence of school curricula with traditional methodologies, according to Loguercio and Del Pino (2006, p. 68, our translation), provides "*students with a distorted image of how scientific concepts are constituted and evolve*". And, according to these authors, teachers, also, due to the characteristics of their formation, in relation to the construction of scientific knowledge, the work of scientists, the methods of science and the image of science, build misunderstandings (LOGUERCIO; DEL PINO, 2006; MATHEWS, 1994; SOLBES; TRAVER, 2001).

Nascimento and Carvalho (2004) rely on Abd-El-Khalick and Lederman (2000) to explain that the option to use history is a way of approaching the epistemology of science in the classroom, appearing as an alternative to traditional science teaching:

> Programs must continue with attempts (to improve student conceptions). Elements of the history and philosophy of science and/or direct instruction in the nature of science are more effective in achieving this end than those using closed or non-reflective activity processes (p. 667, our translation).

Thinking of science as a finished product is to deny the different possibilities for transformation and construction of knowledge. It is to reduce the creative capacity and creativity of students at school, it is to mask a science that is said to be true. It is not allowing new discoveries and creations. The school, as responsible for transmitting scientific knowledge, is able to create countless possibilities to talk about science in school benches, encouraging research from childhood.

> A history of science discipline, or a historical approach to scientific knowledge, has an extraordinary pedagogical value, a great cultural significance that, associated with the Philosophy of Science, has a relevant contribution to the epistemological understanding of the construction of this knowledge. The History and Philosophy of Science can play a facilitating role in the citizen's scientific literacy (LOGUERCIO; DEL PINO, 2006, p. 68, our translation).

If teacher education curricula sought to incorporate Philosophy and History of Science components into their curricula, teachers could discuss science and its different conceptions, as well as scientific knowledge and its teaching. These conceptions would also be built by students, at school, from their early years. In this logic, prior knowledge would be the indicators for the introduction of new knowledge, where science would be built from the lived reality, from cultural, social and political contexts.

Considering prior knowledge as a prerequisite for learning new knowledge, Stengers (2002) states that science must, like any other human practice, be inserted in history and that, from this point of view, there can be no disengagement, nor in between. However, this legitimate ideal allows us to elide problem questions that lead us to ask: why is this insertion of the history and philosophy of science in teacher education not so peaceful? Why are school curricula not able to dialogue with the history of scientific knowledge in its four areas of knowledge? Can the historical contextualization of school subjects parallel to knowledge of the content to be learned help the school in the formation of citizenship for its students? And,

how to make students see science and its relationship with society, technology, culture and politics, in other words, with the world?

The history of science and the construction of citizenship at school

Starting from the problem questions, we want the school to offer a conscious and critical education, encouraging students in their daily lives to make decisions and make adequate choices with the reality they experience. This is an educational ideal in many countries. According to Paixão and Cachapuz (2003, p. 31, our translation) [...], "science education should contribute to form more cultured, more informed and more critical citizens", where scientific knowledge will be confronted with the student's prior knowledge, which may or may not have resistance to new knowledge.

The teacher, as holder of this knowledge, is responsible for seeking strategies to transform common sense into scientific knowledge. One possibility is to show science as a human construction, subject to the influence of social, economic and cultural factors of its time (DEL PINO; STRACK, 2012). Bringing the history of science closer to school and the act of teaching is a challenge that should be pursued based on challenging pedagogical proposals, considering the prior knowledge that students bring from their life experiences.

But in what sense can science education make citizens more educated, more informed and more critical? One of the first theorists to ask himself about the educational value of science was Jean Jacques Rousseau. The Portuguese sociologist Boaventura de Sousa Santos refers to this author, to his famous *Discours sur les Sciences et Les Arts*, second part, a dissertation written for a competition organized by the Academy of Dijon, in which Rousseau asks several questions. These questions pointed to doubts on the Enlightenment's trust in Reason. Boaventura de Souza Santos paraphrases Rousseau's questions as follows

> Is there any relationship between science and virtue? Is there any reason to replace the common knowledge we have of nature and life and which we share with men and women in our society with scientific knowledge produced by the few and inaccessible to the majority? Will science contribute to reducing the growing gap in our society between what one is and what one appears to be, knowing how to say and knowing how to do, between theory and practice? Simple questions that Rousseau answers just as simply, with a round no (SANTOS, 1987, p. 17, our translation).

What Rousseau understood by “virtue” is what we would call today moral excellence and citizen conscience. He asked whether science could contribute to the moral progress of humanity. Rousseau sought answers to these questions at a time when the dominant scientific

paradigm was the mechanistic one, a paradigm that was constituted from the scientific revolution of the 17th century and which had its most complete expression in Newton's Physics. It is opportune here to remember which images of science and Nature were associated with this paradigm. Unlike Aristotelian science that conceived Nature as a great living being, Newtonian mechanism represented it as a machine.

In Rousseau's period, according to Santos (1987), science was not seen as a tool for social emancipation. Its individual emancipatory value was recognized for members of the wealthy classes in the sense of freeing them from religious superstition. On the other hand, it was admitted that science could be useful for the domain and control of Nature, but, as the industrialization process in Europe had not yet started, these technological advances and their applications were not recognized.

Today we would give a different answer to the one given by Rousseau. We see science and technology as essential for society, as they produce different vaccines for various diseases, allow the construction of bridges and roads, and put at our disposal devices that give us comfort, such as refrigerators and cars. But also, science has a role in the construction of values in citizens. If for Rousseau oppression came mainly from religious institutions, today it comes more from political and economic power, and manifests itself in much more subtle ways to the point where it is not seen as such.

The school can contribute to the critical reflection of these traps imposed by political and economic power, transmitting the necessary scientific knowledge so that the student can form his/her critical judgment. Here, educators should remember Descartes (2012), in the book *Rules for Orientation of the Spirit*, when he put as the first rule the following: “the purpose of studies should be to direct the spirit so that it can form solid and true judgments about all the things that are presented to it” (our translation).

In this bias, it is understood that the challenge for teachers, currently, according to Bizzo (2002), is to recognize the real possibility of understanding scientific knowledge and its importance in the education of our students, since it effectively contributes to the expansion of ability to understand and act in the world in which we live. As for Chassot (2003, p. 94, our translation), “[...] it is no longer possible to conceive proposals for the teaching of science, without including in the curricula components that are oriented towards the search for social and personal aspects of students”. “Science can be taken as a way of making sense of the natural and technological world, at the same time it has in mind the construction of responsible citizenship” (PAIXÃO; CACHAPUZ, 2003, p. 31, our translation).

What would be the role of the history of science within this science education? It induces those who know it a sound prudence in the sense of being cautious and not accepting anything that presents itself under the clothes of science as if it were exact science, verified and proven. On the other hand, it shows us the different deceptive faces of pseudoscience. A typical case of pseudoscience is that of Astrology, in which there is an erroneous conception of what it was, until the 17th century, as we identified it as the horoscopes we read today in newspapers and magazines. But, according to Andrey *et al.* (2007), this science is something much more sophisticated and complex. And he explains that Astrology mixed complex mathematical tools with philosophical and magical conceptions. It was a fraud, but difficult to recognize as such. It was supported by rulers eager to predict the future of political events. It was cultivated by people we now recognize as great scientists, including Ptolemy and Kepler. Though harshly criticized by prominent intellectuals such as St. Augustine and Pico de la Mirandola, it survived. It only declined, and was reduced to what it is today, when the Aristotelian conception of the universe was replaced by the Newtonian conception (ANDREY *et al.,* 2007).

Another case of pseudoscience, at the end of the 19th century, is that of theories about the human races and about the superiority of some races over others. These theories mixed racial prejudice with evolutionary doctrines based on Darwin's work and Spencer's philosophy, being considered state policies such as turning the Brazilian population white through European immigration.

Henceforth, the history of science shows us the provisional character of scientific theories. They are the best conjectures that Humanity has at a time in its evolution. Well-thought-out conjectures, but which in the future may be considered partially or totally inadequate. For the eighteenth century, Newtonian physics was the embodiment of truth, and today we are, however, aware of its limitations. It is up to teacher education courses to discuss in their curricula the role of the history of science in society, in the education of citizens, bringing critical reflections to the school benches regarding the evolution of science today and how this science is present in the life of the human being.

Conclusions: an ideal to be achieved

Here, we have defended the need to introduce the history of science both in the teacher formation *curricula* for Basic Education, as well as in school subjects classes, based on the following reasons: a) it allows the teacher to understand several of the reasons that make the

student does not understand their classes; b) it provides dialogue between teachers from different areas of knowledge, especially between teachers coming from the area of human sciences and those with formation in the sciences of nature, mathematics and languages; c) it helps to introduce values that are necessary for the formation of an awareness of citizenship; d) it makes the learning of scientific subjects meaningful for the student.

Valuing students' prior knowledge, relating teachers' educational practices to society and technology are emerging challenges in the 21st century. The teacher formation curricula must pay attention to these demands, providing the future professional of education with knowledge that constitutes the reality of schools, consequently of children and young people.

In order for us to understand ourselves as a citizen who belongs to a society, which spends most of his life on school benches, it is necessary to recover the history of this society, of this education, of the scientific facts belonging to it. And Basic Education is one of the noble spaces for its contextualization, it being up to teachers to mediate the construction of knowledge. Another space is the training of teachers, preparing them for teaching in Basic Education.

We defend a permanent dialogue between the areas of knowledge, a collaborative education process with a view to the formation of citizenship for children and young people, where the learning of school subjects makes them meaningful and applicable to the lived reality. From this perspective, methodologies are suggested that encourage problematization, research projects from a real context, historical rescue of science, as well as its path to the present day.

On the other hand, teacher education curricula need to revisit science as a necessary knowledge of their education, bringing aspects of their history, as well as of society, nature and technology, rescuing and valuing teacher knowledge who are committed to discussing reality, experiences and knowledge of common sense. The history of science enables the knowledge of facts, periods, paradigm shifts, ruptures and uncertainties regarding the events of nature. Teachers in formation need to dialogue about these aspects in order to take this knowledge to their teaching practices.

We consider the history of science an ideal to be achieved by all who work in education and believe that through it we can change reality, making our children and young people citizens of their society.

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